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THE MENACE TO NIAGARA.

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FORECASTS by eminent geologists of the future of Niagara Falls have been much in the public eye and have lost some of their novelty though none of their interest. The great cataract, it is said, is committing suicide, and the physical factors which enter into the process have, it is thought, been carefully weighed. If matters proceed as they are now going, the face of the cataract receding without interruption, the falls are to wear themselves out, or if the dominating crustal movement continues, the escarpment is to be left bare because its waters will be stolen away and turned back into Lake Erie.

These are interesting possibilities, but they hardly rise to the dignity of probabilities, for opposing considerations have been left out of the calculations and even the remote periods assigned to their arrival grow longer and more distant in the face of factors overlooked or not sufficiently estimated. Nothing can be as wrong as mathematics or logic where the premises are wrong; nothing more excusable than the trial forecast for the life of a spectacular natural phenomenon, even though it will be and remain improbable till every factor in play has been given its full share in the process.

The problem of Niagara is not simple. As one sees with each change of the sun a new wonder in its fascinating rush of waters, so every reconsideration of the problem of its natural future brings into activity contributory and qualifying elements before unrecognized.

The intelligent public, now quite familiar with these forecasts, looks upon the Niagara cataract as doomed at some remote time and from causes which human power can not control, and doubtless this

feeling, now that the novelty of the sensation is past, has been followed by an intellectual resignation. Even the claims of posterity, the passing pang that our descendants may not see the mighty cadence of water as our eyes see it, quite relax all hold upon us in view of the fact that after all this may not happen just as represented.

The heavy bed of tough dolomite limestone at the crest of the falls, which is the occasion of their existence, lies above a thick mass of soft shale which easily caves in under the rebound of the falling waters, and by so doing becomes the chief cause of the breaking down of the crest and of the cataract's retreat. This bed of shale runs down into the earth in the direction from which the water comes, the south. It will be out of the reach of the cataract after a while, leaving an escarpment wholly composed of the tough limestone, which will make the problem of retreat thenceforward quite a different one from what it is to-day. There are, moreover, fifty-seven feet of hard dolomites above the crest of the falls over whose edges the water now descends in rapids. As the cataract moves southward by the falling away of its rock face it will grow higher instead of lower, until after it has passed the parting of the waters above Goat Island. Indeed it may become fifty feet higher than it now is and so firmly upheld by the heavy masonry of limestones that caving in must cease and further retreat will be reduced to its slowest terms.

As to the crustal movement whose tendency is to spill the waters westward out of the Erie basin, we may observe that the earth's crust is most uneasy and its movements most uncertain. Nearly every place is going either up or down, few are in a state of actual quietude. These movements have every variety of period: some may be secular, some are known to be relatively brief. Fifty years ago the shore at Percé on the Gaspé coast was going down, the fishermen had to abandon their drying stages and build them farther up the beach, but to-day the shore is coming up again and excavations for the new stages reveal the remains of the old ones which have been buried in the sea for nearly two generations. There is no knowing when the movement now affecting the Niagara region will cease.

Public resignation over the natural but distant fate of Niagara has grown to public concern at its immediate future. It is alleged that the present and contemplated industrial development at Niagara Falls immediately imperils the integrity and perpetuity of that great spectacle. Is this true? If it is, the American and Canadian public who hold this phenomenon in trust for the world ought to know it. However this question may be received and however answered by the interested producer or the disinterested public, it has on more than one occasion been flatly and formally before the people of the State of New York and of the Province of Ontario and has had to be met.

The legislative bodies of these two governments must meet it again, for it is plainly not the present temper of the public to let it pass in uncertainty.

Any citizen of New York or Ontario may justly take a pride in the magnificent industrial development building up about Niagara Falls, even though it is all at the cost of the beauty and magnificence of the cataract. Nowhere else has nature afforded such tremendous power at once available to mankind and calling forth the highest play of his genius. If I could hold a brief for the development of these natural resources it would be the delight of my pen to paint the wealth, the contributions to human comfort which will flow from them. I might argue that nature created this tremendous fall of water for the express purpose of contributing to commercial power and industrial supremacy. Such a brief would lament, as I have heard a distinguished engineer lament, the actual waste of power during the ages in which the great river has been discharging itself in unutterable glory and construe it sinful to neglect the opportunity so lavishly afforded. Such a brief might deride and cachinnate at the possibility of ever diverting enough water from Niagara to make the Falls palpably less, and all these arguments it would not be difficult to enforce with specious reasoning and pleading facts.

The attitude of the man who is willing and ready to see Niagara entirely drained for the wealth it would produce, and only a dreary canyon left to speak of its splendid past, is wholly intelligible, or would be except for the potent facts that wealth and happiness and contentment are purely relative and that the natural forces of the world were not created for the use of man.

The question I have put has been not only asked, but answered, in New York, officially. The abstraction of water from Niagara Falls was condemned by a committee of the constitutional convention appointed to investigate this subject in 1894, when the public had begun to suspect that the legislature had been too free with its gifts of franchises to power companies. It was vigorously and effectively answered by Governor Odell in 1904, who stood out finely against a tremendous pressure brought to bear upon him by the industrial interests, not through any hostility to them, but for the simple sentimental reason that the Falls must be conserved. Few know the courage of this act, but it was a triumph of sentiment and morality which the citizens of New York may well applaud.

The editor of the *POPULAR SCIENCE MONTHLY* has asked me to set forth the facts relating to the situation at Niagara Falls in such form that it may be made clear whether existing and impending conditions there constitute an actual menace to the cataract and its accompanying attractions, or whether public apprehension has been un-

necessarily aroused by a kind of pantophobia which may work a real injustice to industrial progress.

Except for that slender radical element of the community which proudly avows its willingness to see the Falls wholly developed into power all will agree that if danger is impending to the cataract it is time now that the danger be measured and fully apprehended.

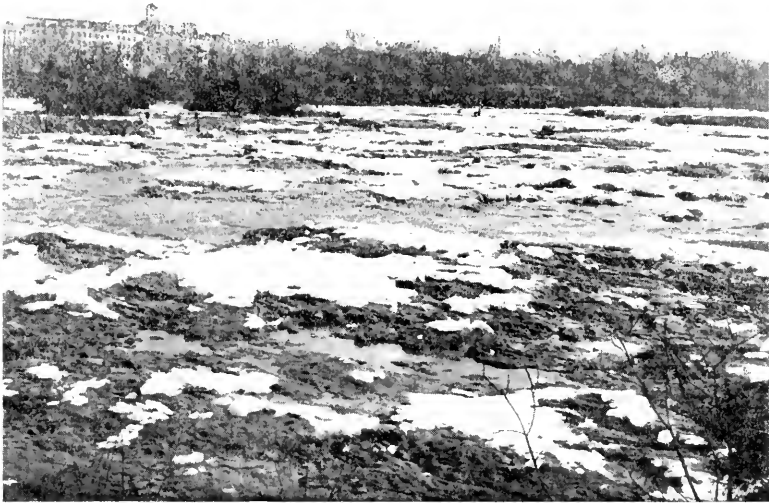
The conservation of Niagara Falls is a question of public morals. Every industrial enterprise of wide scope has as its foundation a moral problem; it can not be simply the producer of great wealth regardless of the rights of others and of the higher claims of community life; nor can it ignore the claims of spiritual excellence and of the higher life which seeks something beyond the minted ideal. This claim of the higher life, the demands of the finer emotions, the love for the beautiful in nature, express themselves in part in the government protection of natural wonders from defacement and destruction; in organizations created to keep alive this sentiment and extend the *aevis* of the state over natural glories which belong to mankind rather than to men. No wise man confesses himself devoid of such emotions.

The violation of this moral principle in present practise offends the best sentiments of the race. It is said that the classic Falls of Lodore have been done to death by conversion into power. The far-famed Falls of Montmorency at Quebec show only a tremulous and weakened front to the traveler on the St. Lawrence, shorn of their glories in order to light the City of Quebec. The City of Rochester, seat of learning, refinement and industrial achievement, has exchanged the beautiful cascades of the Genesee for a slimy canyon. These attacks on natural phenomena have benefited the few, contributed to their comfort and convenience; they have injured the many, robbed them of a natural and proper heritage.

Under the guidance of this principle the claim of the individual, personal or corporate, must give way to the broadly founded rights of the community and the race. Under whatever political control such a majestic demonstration of nature's power may be, this control must be looked upon as a trust rather than the possession of a merchantable commodity or a commercial asset. States have not the moral right to do as they please with such phenomena. In a final analysis the individual or corporate claim to advantage from such a source is wholly extinguished, howsoever expediency may qualify and adjust the conflicting claims.

Wherein does the danger to Niagara Falls from industrial development lie? Simply in the drawing off of its waters from the river above the cataract, carrying them around the cliff by some other way or discharging them by tunnel into the face of the falls near the base.

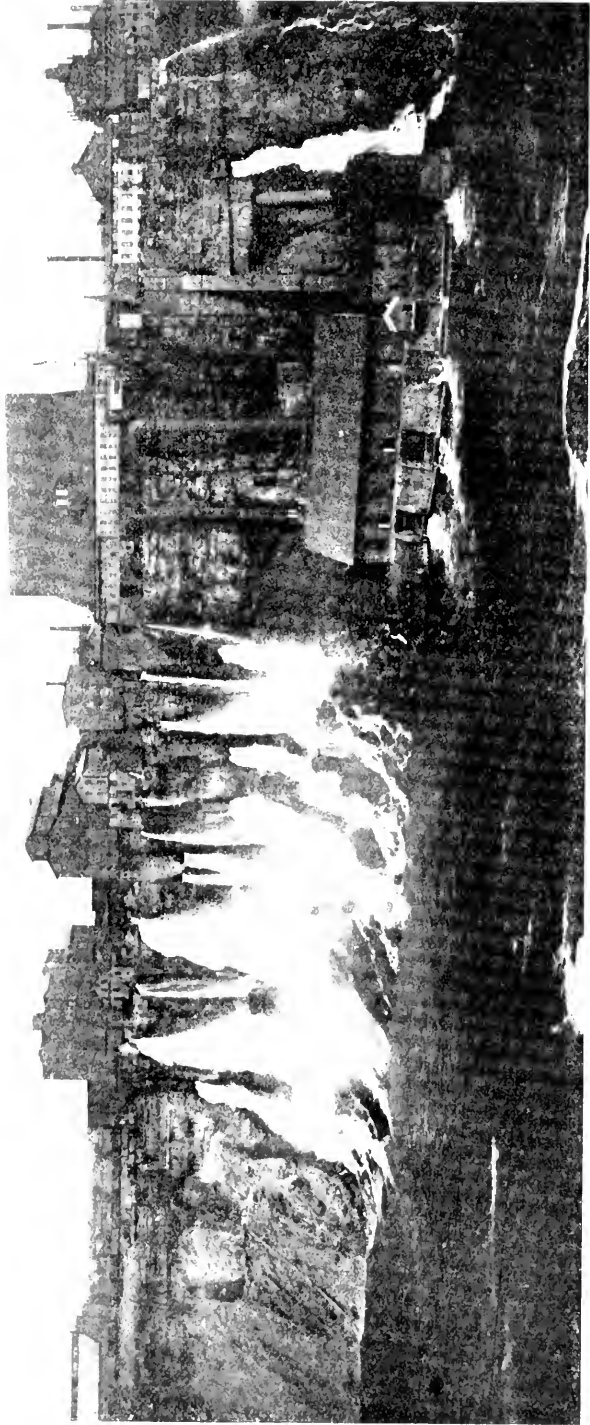
The use of Niagara waters for power production has been the dream of years and its earliest successful achievement is expressed in the present Niagara Falls Hydraulic Power & Manufacturing Co., whose existence as an active consumer of Niagara water antedates its statutory recognition. The legislature of New York began giving away franchises to power companies about twenty years ago. It has never asked a financial return of any sort for any of these, as, during the



THE AMERICAN CHANNEL AT THE CREST OF THE FALLS DURING THE ICE JAM OF MARCH, 1903.

period from 1885 to 1894, when they were most freely granted, it probably seemed not wise to inflict a revenue on a budding industry. New York thus receives nothing whatever in return for the privileges it has granted for the consumption of its own waters. We mention this fact incidentally, just as we may mention that the Canadian companies are to pay a substantial return for similar privileges; but this matter of revenue has no bearing whatever on the theme before us. Whether or not any public revenue be derived from the use of Niagara is entirely beside the issue save as taxation of the product of the companies can be used as a means for the control of the situation.

Nine of these companies have been legally recognized or chartered in New York. Of these charters, all were granted in good faith, but it may be doubted if all were asked for and received in the same spirit. Some, it would seem, were immediately for sale as soon as



A VIEW OF THE AMERICAN BANK, SHOWING THE POWER-HOUSE OF THE N. F. H. P. AND M. CO., THE ENCLOSED TAIL-RACES AND THE GROWING ROW OF STRUCTURES AT THE EDGE OF THE WATER.

granted. Some failed to effect organization because the present requirements of such an undertaking demand enormous capital. Some were limited in respect to the amount of water they may abstract from the river, as the Niagara Falls Hydraulic Power & Manufacturing Co., to 462,000 cubic feet per minute, and the Niagara Falls Power Co., to 516,000 cubic feet per minute. Others were restricted in the amount of power to be produced, as the last named company, which may not exceed 200,000 horse-power. In most cases, however, no limitations were placed either on power to be produced or water to be abstracted. Several were limited as to the time in which they were to begin work in good faith, two of them to five years, two to



THE AMERICAN BANK BELOW THE STEEL ARCH BRIDGE, SHOWING THE WASTE OF WATER AND POWER FROM THE SPILLWAYS AND TAIL-RACES OF THE FACTORIES.

ten years. Three if not four of the charters are dead by limitation, one company sold its franchise to another, one is slumbering with an occasional show of life, another is leading a questionable life and two are producing and selling power.

The Niagara Falls Hydraulic Power & Manufacturing Co. and the Niagara Falls Power Co., the productive organizations, are alone to be credited with the really amazing industrial developments at this place, and they are still far within their statutory limitations in the consumption of water. With this superb display of mechanical achieve-

ment before his eyes one looks and looks in vain for a depauperated and enfeebled cataract. The flow of water is of course diminished, but to the occasional visitor it is but mathematically perceptible. Citizens of Niagara Falls who have the cataract daily before the eye have insisted that the loss of water is perceptible, and that such loss is felt in other ways is seen in the now annual gorging of the ice in the American channel at the upper end of Goat Island, which lays bare the American channel, sends all its water to Canada, and which very rarely happened when the depth of the water was normal.

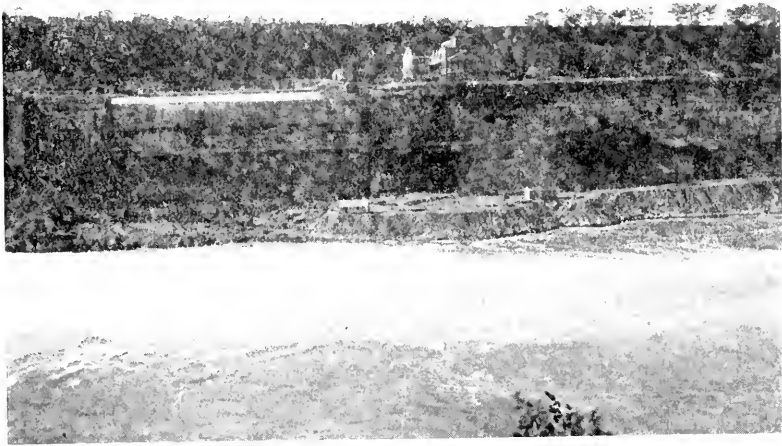
The two active American companies are not going to use any less water than now, but are vigorously increasing their output and building new power houses to meet their growing market. Indeed, one of them, realizing its close approach to statutory limits, has established itself on the Canadian side. These two companies are permitted to consume the following amounts of water:

Niagara Falls Hydraulic Power & Manufacturing Co.	7,700	cu. ft. per sec.
Niagara Falls Power Co.	8,600	" "
	16,300	" "

The water abstracted by these companies is in no small degree wasted, that is to say the power produced is no equable measure of the amount of water taken from the river. This page carries a picture familiar to a thousand eyes—the view of the American bank below the steel arch bridge. This has been termed ‘the backyard view of Niagara. The little cascades springing from holes in the side of the bank at various heights are the wasteways of the factories above. Some of these cascades are now encased in flumes and made productive at the bottom of the cliff, but this is only a recent change designed to save the wasted power, but involving the construction of a row of factories or wheel pits all along the edge of the water. The fall from the height of waters where these two companies have their intakes, to the base of the cataract, is approximately 224 feet, far beyond the working possibility of the turbine pit. The outrush of water at the base of the cliff near the bridge anchorage is the discharge of the great tunnel of the Niagara Falls Power Co., which is the tail-race from the wheel pits far back up the city and far above in the rocks.

On the Canadian side the activity in the erection of power works has been more strenuous. Utter devastation of the natural beauties of Queen Victoria Park, the demolition of islands and creeks, the excavation of the rock surface to the complete obliteration of well-known landmarks, have been the accompaniments of the unparalleled endeavors and achievements here. Whoever has visited this part of the Falls region since the beginning of these gigantic operations has sought in vain for the Dufferin Islands and Crescent Island, and what must have seemed to him an inextricable chaos of rock excavations, of

switches and sidings, of temporary and permanent constructions, in confusion worse confounded, has confronted him. Out of it all, it is presumed, the plans for the *artificial* beautifying of the spot will gradually unfold and the visitor of coming years is to see it with its attractions not only restored, but enhanced.



SITE OF THE POWER-HOUSE OF THE ONTARIO POWER COMPANY AT THE EDGE OF THE WATER BELOW THE FALLS ON THE CANADIAN SIDE.

Great sections of the river bottom, acres of rock over which the river has flowed for ages in tumultuous energy, have been for the first time exposed to the eye of man and the light of the sun. These sections of the river have now in large part been absorbed into fore-bays and intakes, into the permanent constructions of the companies, never to be given back to their proper charge.

The three Canadian companies are to be greater consumers than the American. They are the finest, the most magnificent conceptions of hydraulic engineering, and in their ultimate realization rise to proportions which are an expression of the genius that has inspired them. No one of these, let us remark, is moribund or inactive; each shows the highest type of virility.

The Canadian Niagara Power Co. has a statutory limit of

consumption of	8,900	cu. ft. per sec.
The Ontario Power Co.	12,000	" "
The Toronto & Niagara Power Co.	11,200	" "
	32,100	" "

Adding to this total the limits of the American producing companies (16,300), we have for the entire chartered abstraction of the five companies referred to, 48,400 cubic feet per second.

This is of itself a dry and apparently barren fact. Let us look to its bearings upon the structure of the Niagara River and the total flow of waters through its channel.

The Niagara River flows over a rock bottom, on which the strata dip uniformly to the west. The sill or edge of the Falls is ten feet higher on the American than on the Canadian side, the waters at the crest of the American Falls ten feet shallower.



THE ROCK-BED OF THE RIVER ON THE CANADIAN SIDE, NOW PARTLY ENCLOSED BY PERMANENT CONSTRUCTION.

The flow of water through the channel and over the Falls was measured by the United States engineers in 1868, and by Sir Casimir Gzowski in 1870-3, with results varying from 246,000 cubic feet per second (the latter) to a maximum of 280,000 cubic feet per second (the former). The later averages given by the United States engineers, derived from the mean flow of water from Lake Erie at Buffalo during a period of forty years, afford 222,400 cubic feet per second. There are certain constants of abstraction for the Welland and the Erie canals which may be regarded as equalized by the inflow of streams into the river between Buffalo and the Falls, so that the figure which has been generally accepted and has entered into the calculations

of the engineers is 224,000 cubic feet per second. It is in cubic feet per second that we prefer to express our statements; the attempt to put them in terms of horse-power is attended with too many uncertainties.

The potential or theoretical horse-power of this volume of water falling in the cataract is variously, sometimes carelessly stated in the engineers' reports as from three to six millions. A recalculation gives it at 3,800,000 for the cataract, which would be increased by the additional fall from the height of the rapids to the crest of the Falls. Goat Island, picketing the frontier, divides the waters unfairly, giving much more than three-fourths of their volume to the Canadian side,

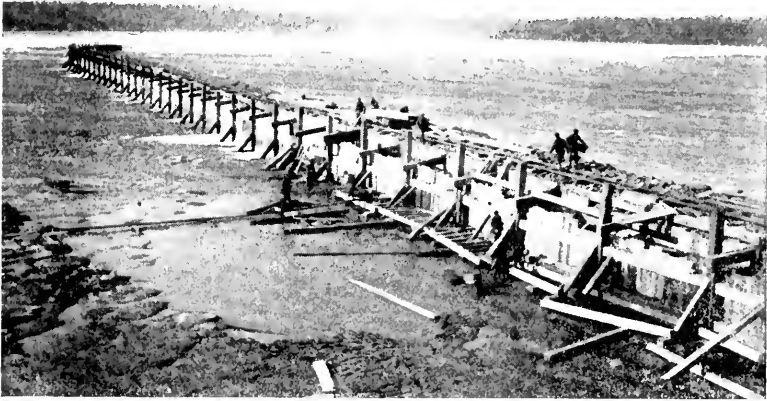


THE ROCK-BED OF THE RIVER, LEFT DRY BY THE WING DAM OF ONE OF THE CANADIAN COMPANIES.

though the international boundary established by the Treaty of Ghent lies at the line of deepest water. Now as less than one fourth of the total volume of the waters pours down the American channel and this channel is much shallower than the other, it is at once evident that abstractions of water will make themselves first perceptible in the shoaling of the American channel. At the parting of the waters above Goat Island the great current of the river moves to the west, and converges into the funnel of the splendid Horseshoe Falls. The American channel actually carries in comparison but a feeble flow and the whole American cataract is in extremely delicate equilibrium.

A competent hydraulic engineer, taking the accepted volume of

the flow, the length of the entire crest of the Falls on both sides (4,070 feet) and the difference in elevation of the sill of the Falls, has calculated that when the flow is reduced to 184,000 cubic feet per second, or by 40,000 cubic feet, the water will be down to the present rock bottom at the edge of the American shore.



WING DAM OF ONE OF THE CANADIAN COMPANIES RUNNING OUT TO THE EDGE OF THE RAPIDS.

Then the American Falls, though still forming a cataract, will be but a ghost of their ancient magnificence; instead of the mighty sheet of emerald waters now spreading in silent majesty over the rock crest, a weakly, thin, white apron of waters carried forward by a slender impulse *a tergo* and the great cadence will have lost its glory. Electric searchlights in all the colors of the rainbow dancing up and over the falling waters and other factitious means of producing a spectacle will never compensate the loss.

Let one fifth more of the water be abstracted beyond the line we have already calculated and the American channel will be dry. That is, in effect, double the amount of 40,000 cubic feet, and when 80,000 cubic feet have been taken away from the present flow the Canadian channel will still be an interesting object, but the American Falls will be wholly gone.

All our figures in these statements and calculations, it may be well to repeat, are taken from the reports of the United States engineers, of the power companies' engineers, or have been specially derived at my solicitation by engineers of high standing.

We may return to the data given concerning present and immediately contemplated abstraction.

The two American and three Canadian companies now in opera-

tion or about to operate, when producing to their charter limits will abstract 48,000 cubic feet per second. That amount will bring the water-level to the bottom of the river at the American shore.

So much then is in immediate prospect. The turning of the waters a few days ago into the largest turbines the world has ever seen, thus inaugurating the actual production of Canadian power, sounded the death knell of the American Falls, leaving to those whose hearts sink and whose spirits shrivel at the thought of this destruction only a slender hope that it may be mechanically impracticable or commercially unprofitable to produce to the maximum amounts.

We are not permitted to stop with this forecast. One of the companies chartered by the legislature of New York and the last so chartered to abstract water from above the Falls, is the Niagara, Lockport & Ontario Power Co. It received in 1894 a franchise without restriction upon the amount of water it might use, but work was to begin in good faith within ten years. It was a modest organization with a slender capital, too slender, as it proved, to begin operations. It did nothing, but in 1904 came to the legislature of New York asking an improved charter enlarging its powers and extending its time. This company proposed to take its water from far above the cataract, as far back as La Salle, and not to return it to the river channel at all, but to carry it off overland by canal to Lockport, emptying it thence into Lake Ontario. The bill passed the legislature, not without commotion, but encountered trouble in the Executive Chamber. We have referred to the veto of this bill by Governor Odell as a fine act. Perhaps it is not necessary to say more, but the act was done in the face of most turbulent and insistent opposition, and it was clearly actuated by a relentless conviction of the higher rights of the citizens of the state. *Ex cathedra* statements by special attorneys and the company's engineers that no damage to the scenic features of the Falls could result, were supplemented by an offer of a tremendous sum to the state treasury for the governor's approval. The veto met with almost universal applause throughout the state. This veto was signed May 15, 1904. The company's old charter was signed May 21, 1894. There remained six days in which the company could get to work under its old charter. There is said to be to-day a slender ditch up south of Lockport, the work of a few men and a few carts, which represents the work done *in good faith* in the six days between May 15 and May 21, 1904. It has become a matter of common knowledge that this company has reorganized since these dates, increasing its capital enormously, and it is also stated that the stock has largely passed from the original organization into the control of one of the great corporations. It now looks as though this company means to do business if the courts have no objection, either

under its old charter or with a new one if it can get it. Its intentions and organization are not a negligible quantity in contemplating what is going to happen to Niagara. Should it succeed in constructing its canal and works it is not likely that with an unrestricted charter the company will consume less than 10,000 cubic feet of water per second, and if we assume this as a fair expression of its mean consumption we must increase the mortgage on the Niagara waters by this amount. It then becomes 58,400 cubic feet per second.

These are then the demands upon the river which are actually in sight.

In the seventh annual report of the Commissioners of the Queen Victoria Niagara Falls Park (1903), Mr. Isham Randolph, of Chicago, advisory engineer for the commissioners, makes, at the request of the board, a report on the 'Further Development of the Niagara River for Power Purposes,' in which he suggests sites for four additional companies to consume in total 29,996 cubic feet of water per second. We may better construe this proposed abstraction as operations under consideration rather than merely as work suggested. If we add the amount to our last figure the result, 88,396 cubic feet per second, leaves the entire American channel as dry as bone.

Such is the situation. We are out in the open with these figures. They are the figures of the engineers themselves. The counter-argument to these statements has been, so far as the writer's experience goes, either incorrect premises or a rather bored smile. Putting aside entirely the merely proposed developments and considering only those actually in process we see how closely we are brought to the dead line for the American cataract.

What are we going to do about it? A small, very small proportion of the community in New York and Ontario is content to let the process continue, even to the extinction of Niagara. This element of these communities is largely directly or indirectly concerned with the industrial developments there. Outside the boundaries of these trustee governments this percentage is greatly less. In the country as a whole, speaking for the general intelligent public, the opposition to this procedure seems so overwhelming as to be practically unanimous. New York long ago recognized the necessity of conserving such of these natural beauties as have fallen to her share and the state reservation at Niagara is one of the most beautiful of parks, lamentably small in view of the present encroachment, but upon it she has spent some millions of dollars. The Province of Ontario joined hands in this endeavor and the Queen Victoria Park was once and will be again a beautiful spot, all the more beautiful, the commissioners think, after the installment of the power companies is complete.

The president of the New York Reservation has stated that 800,000 tourists visit the Falls each year. This is a vast number, bringing in an enormous revenue to the place. No other evidence is required to demonstrate how closely the interest of the whole world is focused on Niagara, for these visitors are representatives of every nation. How many hundreds of thousands will seek out Niagara when the world learns that the Delilah of commerce has shorn it of its glory? Will they traverse the seas to behold the wonders of a breakfast-food factory or of any other industrial triumph? These are everywhere: Niagara is



COMMERCIAL NIAGARA—THE CANADIAN BANK BELOW THE BRIDGE.

unique. To make the problem equable, when will the power developments here put into circulation as many millions of money as do the visitors at the Falls? It is not good business to let the Falls alone?

There is widespread power throughout the country about Niagara, in central and western New York and in southern Ontario—not in concentrated and overwhelming manifestations, but power is running away now in many a stream which might be developed and stored without offense to the world and with profit to the community. While this power lying at our doors is neglected the apology for the desecration of Niagara lacks the ring of sincerity.

There should be a remedy for every public menace. If there is in the American people, especially in the citizens of New York and Ontario, a sturdy purpose to save Niagara, if it is proposed to meet the

problem and solve it, it will be found to possess difficulties enough. The working companies are established in their rights and entirely correct in their demeanor toward the state. The legislature of New York in 1904 memorialized the President upon the subject, urging the initiation of treaty relations with the King of Great Britain having for their purpose the cessation of further abstractions of water. It has been suggested by an influential newspaper that the end may be approached through a presidential commission which shall first determine how much water may be taken from the river without detracting from the scenic effects. Our figures show plainly and cogently that such procedure is useless because too late. They show that even the existing abstraction of water is qualifying the majesty of the Falls and that the contemplated authorized abstraction will carry the work of destruction well toward its finish. No more franchises are likely to be granted by either of the trustee governments. It may be well if these states or the superior government of each should enter into a treaty agreement to insure this result, but the danger-point being so near, in fact constructively passed, protection for Niagara means *control of power production*. The hope lies herein, that the companies, either through mechanical limitations, difficulties of cheap production or cheap transportation to a distant market, or through taxation of their product, may not be able to reach the volume of abstraction which is to seriously involve the splendor of the cataract. In this age of marvels, no present mechanical obstacles will long hold sway; the genius of man will overcome them all. In taxation of the power product, not necessarily for revenue but for protection, seems to me to lie the sole means of control of the problem, the only way of saving our national pride before the bar of the world.



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